own country both glass compositions and processes had to be extemporised in a great hurry, and it is indeed creditable to workers like Sir Herbert Jackson outside the factory, and Dr. M. W. Travers, Dr. C. J. Peddle, and Mr. John Kaye inside the factories, that glass vessels at least as durable chemically as any produced in Germany were forthcoming in so short a time. The earlier samples, just like those from Jena, when chemical ware was first made there in 1893, were far from being mechanically perfect. Processes and methods for the graduation of instruments had likewise to be worked out, and it has to be borne in mind that such work was in some instances taken up by persons who were more enthusiastic than competent. Many British people find it difficult to forget these early defects and have been ever ready to sigh for the return of German goods.

The work at Jena, which began about 1881, had ample time to be carried out systematically. The success of the work was due not altogether to the application of new elements to glassmaking but rather to the facilities for a great number of experimental meltings, some of them on a considerable scale, in which the influence of oxides, such as boric, zinc, barium, magnesium, and phosphoric, could be more fully investigated than had been the case by earlier workers. In this way there was gradually built up a series of definite relationships between chemical composition and physical properties, on the basis of which not only were new optical glasses devised but a new type of glass for laboratory use finally developed. Abbe himself was so impressed with the need of financial assistance in these undertakings and with the time consumed in carrying them out as to write: "The difficulties connected with such undertakings are so great, the initial outlay required is so heavy, and success if attained lies so far in the future, that there is little inducement to enterprise. A revolution of the industry can scarcely be brought about in any other way than by the means for its advancement being provided in liberal measure, either by corporations or public authorities."

Both scientific workers and manufacturers in the United Kingdom have well realised the truth of Abbe's remarks, and the user of scientific glass should also understand it. Since the war, despite the severe disappointment of the manufacturer in this country at the support given him, research has gone on continuously. A new type of chemical glassware has appeared on the British market, marking a departure in some ways from previous types and compositions, and as the results of extensive researches now in operation in this country become more and more complete, it is highly probable that still further types will be developed.

It is very likely that the Jena workers in later years acquired much systematic information that was never published. We have done very much here recently to revise the data which they have published and to show in some ways that it was defective and incomplete; while many other lines of research in this country, with the fundamental researches carried out in America, have given us resources of information which the German workers did not possess.

The very fact that, since the war, four new institutions, namely, the Department of Glass Technology at Sheffield, the Society of Glass Technology, the British Scientific Instrument Manufacturers' Research Association, and the Glass Research Association, have not only come into existence, but have also continued in full operation, affords convincing evidence that our manufacturers of scientific glassware are not content with their present attempts but are reaching out for something better. In this endeavour they are worthy of all the help and support, as well as patience, which the body of scientific workers can give them.

Our Nearest Living Relatives.

The Origin and Evolution of the Human Dentition. By Prof. William K. Gregory. Pp. xviii + 548 + 15 plates. (Baltimore, Md.: Williams and Wilkins Co., 1922.) n.p.

IT has so happened that Dr. W. K. Gregory, of the American Museum of Natural History, New York, and the writer of this review have each set out, at an early point in their lives, to seek for a definite answer to the same question: what is Man's lineage? Is he but a branch of the stem which gave the world its great living anthropoid apes—the gorilla, chimpanzee, and orang—or must we carry our lineage into a remote geological past to find the point of its separate emergence from the primate phylum? The reviewer approached the problem by making an elaborate analysis of the structural "make-up" of man and of anthropoid apes, noting the kind and extent of their common heritage and the kind and extent of the structural features peculiar to each, which therefore may be regarded as latter-day acquisitions.

Dr. Gregory has sought an answer by following a totally different route. He has approached it by following the geological record; he has an unrivalled knowledge of the fossil remains of early forms of primates found so abundantly in the Eocene deposits of North America; and as teeth and jaws, or fragments of them, are the most persistent parts of the mammalian skeleton, it has come about that the geological history of the various orders of mammals has to be based on an interpretation of dental hieroglyphics. In deciphering the ancient alphabet of the teeth, particularly as regards the teeth of primate forms, Dr. Gregory is our most highly trained expert. The survey he has now issued embraces not only the American tarsioid and lemuroid fossil forms, lying in or near the basal phylum which has given us our modern apes and lemurs, but also includes an examination of the corresponding fossil forms found in Europe. He deals minutely with the fossil remains of apes found in the Oligocene deposits of Egypt, the anthropoid remains found in the Miocene and Pliocene deposits of Europe and of India—particularly those described in 1915 by Dr. G. E. Pilgrim, of the Indian Geological Survey,—and the various discoveries which have been made of fossil human remains.

Although the routes chosen by Dr. Gregory and by the reviewer have been different they have led to exactly the same goal—namely, that the gorilla, chimpanzee, and man are twigs growing from the same branch of the great primate stem. "Taken as a whole," writes Dr. Gregory, "the testimony of comparative anatomy affords cumulative evidence for Darwin's inference *that some ancient member of the anthropomorphous sub-group gave birth to man.* The detailed studies of the dentition in Part IV. of this work leads me to the conclusion that *the ancient member of the anthropomorphous sub-group* was closely allied to, or even identical with Sivapithecus or Dryopithecus of the Miocene Simiinae."

The reviewer agrees with Dr. Gregory that, on comparing the structural "make-up" of man with that of the great anthropoid apes, "the resemblances are far more numerous, detailed, and fundamental than the differences"; the reviewer would go further and say that in any theory of human lineage the common origin of man, the gorilla, chimpanzee, and orang, must be regarded as a "fixed point" in framing all our speculations. At this early stage in our search for man's pedigree, with only fragmentary documents at our disposal, and with yawning gaps in our book of evidence, complete unanimity between any two investigators cannot be expected.

In Dr. Gregory's opinion mankind is, in a geological sense, a recent product. So late as mid-Miocene times—about a million of years ago if we accept Dr. Gregory's rough estimate—he believes that our ancestry was represented by such fossil forms as Sivapithecus or Dryopithecus—which, so far as we yet know them, must be regarded as true anthropoid apes, not very different from the chimpanzee and gorilla. There is no ground for supposing that in foot or in brain they possessed any trace of the adaptations which have become so pronounced features of the human body. The life-periods and the rate of reproduction of this ancestral stock must have been of the anthropoid order, namely, about seven generations to the century.

In the period postulated by Dr. Gregory for man's differentiation there would have been some 70,000 generations. The representatives of mankind we encounter by mid-Pleistocene times have already a brain which has three times the volume of the chimpanzee brain. Is it possible to conceive a brain like that of the chimpanzee, although constituted upon the same structural and functional plan as is the human organ, attaining a human standard in the course of 70,000 generations? It is true that the discoveries of Dr. Ariens Kappers have shown that the countless myriads of nerve units which make up the human brain are, during the period of development, controlled and grouped by a mechanism the nature of which we can only guess at as yet. Making all allowances on this score, the reviewer cannot conceive the possibility of the extreme structural and functional complexity of the human brain having been evolved from an anthropoid stage in the course of 70,000 generations. While Dr. Gregory is inclined to accept our present knowledge of the geological record at its face value and trace man's origin from an anthropoid of the mid-Miocene period, the reviewer would make allowances for the great blanks in our geological record, which further discoveries will make good, and assume a pre-Miocene date for the divergence of the phyla of man and great anthropoids. It is very difficult to believe that the human brain arose as mushroom-like growth.

Those who have made systematic attempts to determine the evolutionary relationship of one animal form to another know well that it cannot be settled on the evidence of one set of organs; all the structural systems of the body have to be taken into account. Often the evidence of one system—such as that of the teeth, which go with the alimentary system—will seem to clash with or contradict the evidence of other systems. Dr. Gregory is too experienced an evolutionist to make a mistake in this respect; whenever possible he supports or modifies the conclusions reached on dental evidence by appealing to testimony afforded by other systems of the body. Even when this is done it becomes abundantly clear that evolution has not worked on the body of man, ape, or of any animal form whatsoever in a simple and straightforward manner. For example, in that primitive but aberrant primate Tarsius, the embryo establishes itself in the maternal womb in exactly the same manner as do the developing ova of man and anthropoids, and yet the monkeys of the New and of the Old World, which have a simpler type of placentation, are yet infinitely more akin to man and anthropoids in a structural and evolutionary sense than is Tarsius—in spite of this and other unexpected human likenesses possessed by the latter. To account for the irregular distribution of certain characters possessed by man and Tarsius, Prof. Wood Jones has put forward the claims of owl-eyed Tarsius to pose as one of man's near relatives.

The relationships of Tarsius to man, says Dr. Gregory, "are plainly very indirect and must be traced backwards along gradually converging lines to the primitive tarsioid stocks, which gave rise at different times and at different places to the higher groups of primates." As it has a bearing on such problems as the irregular distribution of the human mode of placentation among the primates, Dr. Gregory quotes with approval a principle enunciated by Dr. Henry Fairfield Osborn in 1908 and "familiar to all close students of mammalian phylogeny, namely, that identical characters are often developed by divergent descendants of a common stock." To the master morphologists of our studenthood days such a statement would have sounded heretical or metaphysical, but to those who are familiar with the complex mechanism of hormones, which regulate the growth of diverse structural elements so that they are moulded to serve a common functional purpose, this statement, made by one who has given a lifetime to the observation of fossil forms, has become of easy acceptance to those who are studying the development and growth of living forms. Our difficulties of accounting for the composite make-up of the human body and of that of his congeners, the anthropoid apes, will disappear once we have mastered the growth mechanisms which lead to the creation of structural modifications and the suppression and perhaps resuscitation of old features.

The reviewer has merely noted here the chief conclusions which years of careful toil have permitted Dr. Gregory to formulate concerning man's origin. The main value of the work he has now published is to provide students of the higher mammalian forms with an indispensable dictionary for the interpretation of dental hieroglyphics. Out of a restricted alphabet, Nature has fashioned teeth into a most elaborate and significant language. How these elements are manipulated so as to provide a profusion and variety of dental forms we do not know but it is clear to the least initiated that upper and lower teeth have to be so fashioned, while still embedded in the gums, that when they come into place in the jaws they will fit each other just as a key does its lock. There must be a correlating mechanism at work to harmonise the bite of opposing cusps. Of this Dr. Gregory is fully cognisant, but we regret that he has not abandoned the confusing system of naming the cusps of molar teeth introduced by Dr. Osborn. In this system the names given to the cusps of upper molar teeth are reversed when applied to the cusps of lower teeth—a method with all the perplexing attributes of a reflected image. Besides, as Dr. Gregory has frankly admitted, the system, which has served a good purpose in its time, is really founded on an erroneous interpretation.

Another small and personal grudge the reviewer may also give vent to—the introduction of the new-fangled nomenclature for the old and well-established generic names we have hitherto been accustomed to give to apes and monkeys. But the reviewer's last words must be those of admiration and of thanks for a standard work.

A. Keith.

A Reflective Observer.

A Philosopher with Nature. By Benjamin Kidd. Pp. vii + 211. (London: Methuen and Co., Ltd., 1921.) 6s. net.

Mr. BENJAMIN KIDD was a keen observer of Nature, particularly interested in the problems of animal behaviour and all that throws light on evolution. This volume is a collection of his essays; with the exception of the first two, which deal very attractively with the birds of the Severn estuary, they have been previously published in serials. But in collected form they are very welcome. In all cases there is a characteristic reflective note: What is the deeper significance of this or that occurrence? The primitive language, among birds for example, is undoubtedly a language of the emotions, but it is interesting to notice that it is often a kind of *lingua franca* understood even by widely different species. The young of the mallard, which has probably been the most universally hunted creature on earth, nestle on the observer's bare feet without the slightest instinctive fear. "You take one of them in your hand, and this heir of the ages of the blood-feud shows no fear of you, even tilting its little beak to look inquiringly in your face; evidently thinking no evil, to all appearance hoping all things and believing all things, but certainly quite willing to take you on your merits for good or evil entirely without prejudice." The mother bird is on a tussock near by, "chattering with emotion, every feather quivering with excitement. The hold of the Great Terror of Man is upon her. In a few days, nay, in a few hours, she will have taught it to them, and they will have passed irrevocably into another world." Character is a product of "Nature" and "Nurture."

An interesting experiment was made with a colony of humble-bees which Mr. Kidd kept on his window-